ESSENTIALS

ESSENTIAL PRACTICAL PRESCRIBING

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WILEY Blackwell

Essential Practical Prescribing

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Preface

This textbook was inspired by the need for a practical prescribing textbook for medical students and junior doctors. In a 2009 General Medical Council (GMC) report, 9% of hospital prescriptions contained errors, where 18.7% of these were made by junior doctors (Dornan *et al.*, 2009). A 2008 GMC report of newly qualified UK doctors showed that prescribing was the 'main area of practice in which errors were reported by respondents, indicating a significant potential risk' (Illing *et al.*, 2008). Aside from these figures, the initial inspiration for the book came from my own and others' personal experiences of being a doctor training in busy UK hospitals. Starting as a doctor is daunting, particularly due to the sudden weight of responsibility, much of which lies in prescribing medications. A National Patient Safety Agency study in 2007 found that 32% of the most serious UK drug error incidents were caused by prescribing (NPSA, 2009). When I (GW) started I would have certainly found a practical prescribing book beneficial, as common prescriptions do not become embedded in your memory until you have had the experience to draw back on.

Later on, whilst teaching medical students in the Great Western Hospital Swindon, it became clear that many were worried about becoming junior doctors, where prescribing was a major theme. I and the co-authors (working as clinical teaching fellows or with regular teaching roles) therefore ran prescribing tutorials for medical students, and received hugely positive feedback from them. This encouraged us to publish the data from the tutorials, present at conferences and ultimately write this textbook.

We believe our textbook fills a gap in a critical subject area by relating to medical students and junior doctors in a practical and accessible way. We have tried to ensure this by basing it on our own experiences as junior doctors. It is concise enough to be used as a ward guide, particularly as the DRUGS Checklists provide a quick summary of how to write prescriptions. The book also contains MCQs on a companion website (see the link at the end of each chapter) for those revising for the Prescribing Skills Assessment or wanting to test their knowledge. The website also has easily accessible DRUGS Checklist boxes, where important information is condensed for ease of reference.

We hope this book helps you to avoid mistakes, learn tips from doctors who have gone before you and be the best doctor you can be. Good Luck!

Georgia Woodfield
Benedict Lyle Phillips
Victoria Taylor
Amy Hawkins
Andrew Stanton

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Chapter 6 Neurology: Dr Stephan Hinze, Neurology Consultant at the Great Western Hospital, Swindon

Chapter 7 Surgery: Dr Tony Pickworth, Consultant Anaesthetist at the Great Western Hospital Swindon

Chapter 8 Care of the Elderly: Dr Sameer Maini, Care of the Elderly Consultant at the Great Western Hospital, Swindon

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Chapter 15 Diabetes: Professor Andy Levy, Consultant Endocrinologist, University Hospitals, Bristol

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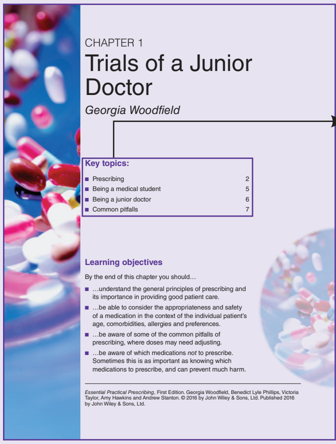
How to use your textbook

Features contained within your textbook

Every chapter begins with **key topics** of the chapter and the **learning objectives** to the topic.

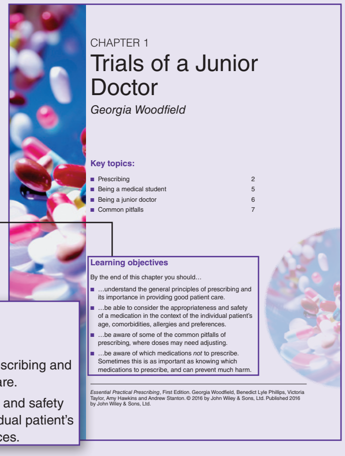
◀ **Key topics** give a summary of the topics covered in a chapter.

Learning objectives describe the main learning points in a chapter.



Key topics:

- Prescribing
- Being a medical student
- Being a junior doctor
- Common pitfalls

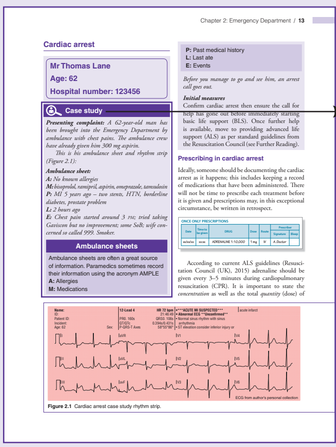


Learning objectives

By the end of this chapter you should…

- …understand the general principles of prescribing and its importance in providing good patient care.
- …be able to consider the appropriateness and safety of a medication in the context of the individual patient's age, comorbidities, allergies and preferences.

Case studies give practical clinical examples of prescribing for each key topic



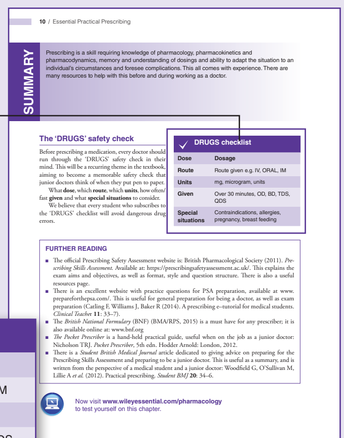
Case study

Presenting complaint: *A 62-year-old man has been brought into the Emergency Department by ambulance with chest pains. The ambulance crew have already given him 300 mg aspirin.*

This is his ambulance sheet and rhythm strip (Figure 2.1):

Ambulance sheet:
A: *No known allergies*
M: *bisoprolol, ramipril, aspirin, omeprazole, tamsulosin*
P: *MI 5 years ago – two stents, HTN, borderline diabetes, prostate problem*
L: *2 hours ago*
E: *Chest pain started around 3* PM*; tried taking Gaviscon but no improvement; some SoB; wife concerned so called 999. Smoker.*

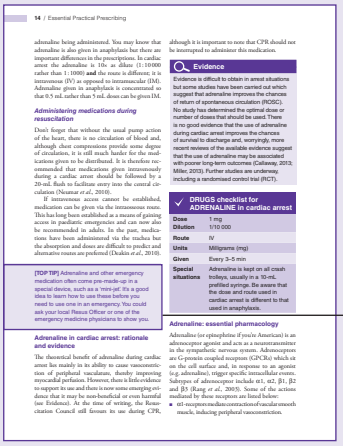
DRUGS checklists give the Dose/Route/Units/Given/Special Situations for each drug discussed in the book. These are also available on the companion website.



DRUGS checklist

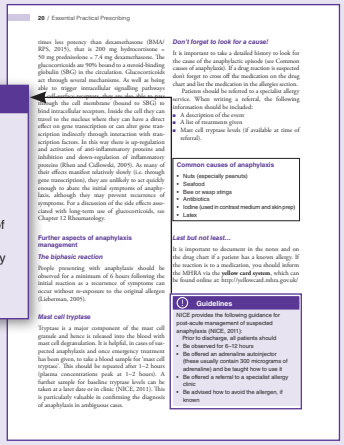
Dose	**Dosage**
Route	Route given e.g. IV, ORAL, IM
Units	mg, microgram, units
Given	Over 30 minutes, OD, BD, TDS, QDS
Special situations	Contraindications, allergies, pregnancy, breast feeding

▶ **Top tip boxes** give inside information on a topic.

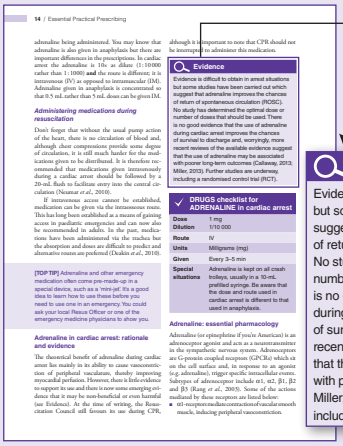


[TOP TIP] Adrenaline and other emergency medication often come pre-made-up in a special device, such as a 'mini-jet'. It's a good idea to learn how to use these before you need to use one in an emergency. You could ask your local Resus Officer or one of the emergency medicine physicians to show you.

▶ **Guidelines boxes** direct you to the latest online guidance on a topic.



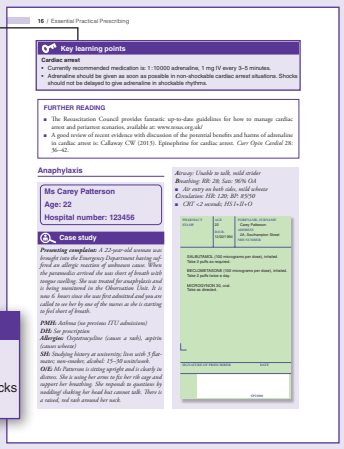
Evidence boxes direct you to the key evidence and drug trials on a topic.



Evidence

Evidence is difficult to obtain in arrest situations but some studies have been carried out which suggest that adrenaline improves the chances of return of spontaneous circulation (ROSC). No study has determined the optimal dose or number of doses that should be used. There is no good evidence that the use of adrenaline during cardiac arrest improves the chances of survival to discharge and, worryingly, more recent reviews of the available evidence suggest that the use of adrenaline may be associated with poorer long-term outcomes (Callaway, 2013; Miller, 2013). Further studies are underway, including a randomised control trial (RCT).

Key learning points boxes give a summary of the topics covered in a section.



Key learning points

Cardiac arrest

- Currently recommended medication is: 1 : 10 000 adrenaline, 1 mg IV every 3–5 minutes.
- Adrenaline should be given as soon as possible in non-shockable cardiac arrest situations. Shocks should not be delayed to give adrenaline in shockable rhythms.

About the companion website

Don't forget to visit the companion website for this book:

www.wileyessential.com/prescribing

There you will find valuable material designed to enhance your learning, including:

- MCQs
- Downloadable DRUGS checklists

Scan this QR code to visit the companion website

CHAPTER 1

Trials of a Junior Doctor

Georgia Woodfield

Key topics:

Learning objectives

By the end of this chapter you should…

- …understand the general principles of prescribing and its importance in providing good patient care.
- …be able to consider the appropriateness and safety of a medication in the context of the individual patient's age, comorbidities, allergies and preferences.
- …be aware of some of the common pitfalls of prescribing, where doses may need adjusting.
- …be aware of which medications *not* to prescribe. Sometimes this is as important as knowing which medications to prescribe, and can prevent much harm.

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Prescribing

Introduction

Prescribing is a daunting task as a junior doctor. No pharmacology textbook can prepare you for the responsibility of signing your name to a drug and giving it to your patient. The best preparation is practice but there are a few key principles that will prevent major errors being made. It is well recognised that drug errors are a major cause of patient morbidity and mortality, hence prescribing was a key area targeted by the National Patient Safety Agency (NPSA, 2007). In a 2009 GMC report, 9% of hospital prescriptions contained errors, with FY1 doctors making 8.4% of prescription errors and FY2 doctors making 10.3% of errors (highest error rate) in 19 UK hospitals on 7 days. In addition, a 2008 GMC report of medical students moving to FY1 showed prescribing was the 'main area of practice in which errors were reported, indicating a significant potential risk' (GMC, 2008). One conclusion for the 2012 review of Tomorrow's Doctors guidance (GMC, 2009a) was that development of ward-based teaching of prescribing should be supported.

General prescribing principles

A few basic rules go a long way with regards to writing a drug on a drug chart. With every prescription, all of the following need to be clearly specified; then there can be no mistake with the prescription side of things:

- Correctly identify the patient with at least three identifiers on the drug chart: full name, date of birth, NHS number (these three are the legal minimum) and hospital number.
- Write the date and time.
- All allergies must be written clearly at the front of the drug chart.
- Write the drug in the correct section of the chart: once-only drugs, regular, as required, variable prescriptions, infusions and fluids section; some charts have a dedicated thromboprophylaxis section, insulin section and antibiotic section.
- Write the drug name clearly, with its formulation if required (e.g. insulin is not enough, the formulation has to be specified, e.g. NovoRapid insulin) and ideally in capital letters for clarity.
- Choose the correct dose with clear units. Milligrams can be abbreviated to mg and millilitres to mL, whereas 'units' must be written in full, as must 'microgram' or 'microlitre' to prevent confusion with a mu (μ) abbreviation.
- The route must be specified. Oral can be abbreviated to PO, intravenous to IV, intramuscular to IM, subcutaneous to SC and topical to TOP (Table 1.1).
- The timing must be specified. Once daily can be abbreviated to OD, twice daily can be abbreviated to BD, three times daily can be abbreviated to TDS, four times daily can be abbreviated to QDS. 'As required' can be abbreviated to PRN but the maximum frequency has to be specified. Any other frequencies should be written in full for clarity, e.g. 'every Monday, Wednesday and Friday'. Don't forget to cross through days where the drug is not required to ensure it is not administered by accident. The frequency and specific hour is clarified by circling the corresponding time on the prescription chart.
- A start and stop date (if applicable) must be specified.

Table 1.1 Abbreviations used to indicate drug timings.

Abbreviation	Latin	English translation
OD	Omne die	Once daily
BD	Bis die	Twice daily
TDS	Ter die sumendus	Three time per day
QDS	Quarta die sumendus	Four times per day
OM	Omne mane	Every morning
ON	Omne nocte	Every evening
PRN	Pro re nata	As needed
Stat	Statim	Immediately

- The indication must be specified for all antibiotics and unusual or important drugs that must not be stopped, e.g. trimethoprim for urinary tract infection, tacrolimus for renal transplant. The more information the better.
- Any further instructions go into the 'additional information' box, e.g. alendronate requires the patient to stay upright for 30 minutes following ingestion. Often the pharmacist will add this specific information.
- The prescriber's signature and printed name must accompany every prescription, as well as a contact number or bleep.

Navigating a drug chart

Most drug charts follow a set pattern and layout. There is a dedicated section for once-only drugs, regular, as required and variable prescription (Figure 1.1). There is usually an infusion and fluids section, but this can be on a separate chart. Some charts have a dedicated thromboprophylaxis section, antibiotic section and insulin section.

Calculating drug doses

There are number of drugs that require weight-specific prescriptions. For instance, enoxaparin at a therapeutic dose for treatment of deep vein thrombosis/pulmonary embolism (DVT/PE) has to be given at 1.5 mg per kg. This may be reduced to 1 mg per kg in renal impairment. Many drugs need half-dose reduction in renal failure; see Common pitfalls section.

However, the most confusing drug dosings to calculate are the infusion rates, as medics are so used to prescribing in mg rather than mL per hour. This involves checking the concentration of the drug (e.g. 1 mg per mL), then prescribing both the number of mg but also the corresponding number of mL per hour. One tip for this is using the drug administrations guide that nurses will have on every ward. This specifies the different available preparations of drugs, their concentration, which crystalloid they should be mixed with and the speed of administration. Always check calculations, and ask pharmacists to help with unfamiliar drugs.

Using the British National Formulary

The *British National Formulary* (BNF) (BMA/RPS, 2015) can be hard to use at first, but is a great resource which is nationally recognised and updated every 6 months. A common initial difficulty with the BNF is that it works strictly by drug and classes of drug, rather than by conditions. It therefore relies on you knowing which drug you require and the indication. It will not tell you alternate drugs to use for a certain condition. Sometimes the clinical situation, therefore, does not tally with the situation in the BNF, leaving the inexperienced prescriber unsure how to proceed. One solution to this are books such as the *Pocket Prescriber* (Nicholson, 2012). This is small, portable and easy to use for common prescriptions. The BNF app on the iPhone is also free of charge and very handy, needing no internet connection. Also, do not be afraid to ask a pharmacist.

Importantly, the BNF has a subsection for each drug detailing indications, cautions, contraindications, considerations in hepatic and renal impairment, pregnancy and breastfeeding, as well as a pretty exhaustive list of side effects. There is also an entire section (appendix 1) detailing possible drug interactions (BMA/RPS, 2015).

Prescribing blood products

Prescribing blood is similar to prescribing any other medication, except that there is usually a dedicated prescribing chart for blood products, which is also separate from the fluid prescribing chart. The specific blood component must be specified, for example packed red cells (what is conventionally thought of as a blood transfusion), platelets, fresh frozen plasma (FFP), cryoprecipitate and factor VIII. Blood products are prescribed by number of units (or number of pools in the case of platelets) rather than as a volume. This is because the volume varies each time. The time over which the unit is run is important, as the maximum time over which 1 unit of packed red calls can run is 4 hours. This is to prevent the blood spending too long at an ambient temperature, which could allow bacterial proliferation and clots to form. Platelets generally consist of a lower volume and are run through quickly, as is FFP as this is usually given in large

Surname	Hospital number	Weight	Drug intolerances
First name	Date of birth		

REGULAR PRESCRIPTIONS

	Circle/enter times below ↓	↘ Enter dates below	Month:	Year:
DRUG	06			
Dose / Route / Freq / Start date	08			
Signature / Bleep / Review	12			
Additional instructions	16			
	18			
	22			
DRUG	06			
Dose / Route / Freq / Start date	08			
Signature / Bleep / Review	12			
Additional instructions	16			
	18			
	22			
DRUG	06			
Dose / Route / Freq / Start date	08			
Signature / Bleep / Review	12			
Additional instructions	16			
	18			
	22			

ONCE ONLY PRESCRIPTIONS

Date	Time to be given	DRUG	Dose	Route	Prescriber		Administration		
					Signature	Bleep	Date given	Time given	Given by

OXYGEN

Target SpO_2	○ 94–98% ○ 88–92%
Mode of delivery	○ Continuous ○ As required
Starting device	
Initials / Bleep / Date	

AS REQUIRED MEDICATION

DRUG				Date													
				Time													
Dose	Route	Max freq	Start date	Dose													
				Route													
Signature/Bleep		Max dose in 24 hrs	Review	Given													
				Check													
Additional instructions																	
DRUG				Date													
				Time													
Dose	Route	Max freq	Start date	Dose													
				Route													
Signature/Bleep		Max dose in 24 hrs	Review	Given													
				Check													
Additional instructions																	

INFUSION PRESCRIPTIONS

Date	Time	Fluid	Vol	Drug	Dose	Rate	Doctor initials	Nurse initials	Batch no.	Start time	Stop time

Figure 1.1 A blank drug chart showing typical sections for regular, once-only, as-required and infusion medications.

bleed situations. Please see Chapter 7 Surgery to understand blood product prescribing more fully.

Prescribing fluids

All UK hospitals will have a section of the drug chart or a separate prescription form for IV fluids. The type of fluid, volume, speed of administration and any additives need to be specified. Please see the Fluid Management section of Chapter 7 Surgery for more detailed information about fluid prescribing.

Factors to consider when prescribing

There are a few other factors to consider when prescribing, apart from the correctness and clarity of the prescription itself. These start with patient choice and preferences. Sometimes patients have ideas and opinions regarding preferences for drug formulations and drug classes. For instance, some patients find ranitidine a more effective treatment for acid reflux than omeprazole, even though omeprazole has more evidence for its use. As the aim of this treatment is relief of symptoms, patient preference is the most important factor here.

Another important consideration is the legality surrounding prescribing. The prescription is a legal record of drug administration and hence needs to be a clear document providing factual evidence of what occurred, as well as recording the accountable parties. These parties would include the prescriber (mainly) but also the professional who administered the drug. It is therefore in your interest as a doctor to make all prescriptions as clear and informative as possible, as any mistakes could be directly attributed to you however good the intention. This is crucial in the age of increasing litigation and where dangerous agents are being administered to patients who are putting their faith in the medical profession.

Some drugs come in multiple formulations, where some may be more effective for certain conditions. For example, mesalazine for inflammatory bowel disease comes in numerous preparations such as Pentasa, which is occasionally used for Crohn's disease, whereas Asacol is commonly used for ulcerative colitis. In a similar way, morphine preparations vary in their speed of onset, duration and tolerance between patients.

Cost of medications is also a consideration, but not generally for a junior doctor. Cheapest options are generally tried first, for example omeprazole, before changing to more expensive products in the drug class such as esomeprazole if effectiveness or tolerability is an issue.

Being a medical student

Preparing for the prescribing skills assessment

Prescribing is a daunting task as a junior doctor. No pharmacology textbook can prepare you for the responsibility of signing your name to a drug and giving it to your patient. However, despite the immediate need for junior doctors to prescribe drugs safely and effectively upon qualification (GMC, 2009b), there is variation in how this is taught at universities. For this reason the Prescribing Skills Assessment (PSA) has been developed to ensure a basic level of understanding and experience in prescribing before graduation.

In order to practise as a foundation doctor in some deaneries (from August 2015), this examination must be passed, and has been adopted by many medical schools as a component of finals examinations.

The content of the exam is designed to represent common scenarios and test essential knowledge. The majority of questions therefore focus on medical emergencies such as chronic obstructive pulmonary disease (COPD) exacerbations, asthma attacks, pulmonary oedema and acute coronary syndrome. The questions that many find most difficult are about side effects and interactions of commonly prescribed drugs. These can be looked up in the BNF (BMA/RPS, 2015), but this is time consuming and stressful in an exam situation, particularly because the BNF tends to list every side effect without discussing the most important. It is therefore worth knowing side effects of commonly prescribed drugs such as statins and beta blockers before the exam. The best way to prepare for the PSA is therefore to revise medical emergency prescribing and common drugs, rather than trying to learn long lists of side effects of less common drugs. Useful books are therefore those that focus in on these common scenarios and are perhaps less detailed, such as the *Pocket Prescriber*. This has a section on medical emergencies, which includes information on side

effects and interactions of specific drugs (Nicholson, 2012). Other useful resources are the BNF, NICE guidelines on common treatment regimens, as well as pharmacology text books.

Preparing to be an FY1

The PSA is based on scenarios that junior doctors prescribe for, so preparing for the PSA is excellent practice for FY1. However, theory of prescribing is one thing, but problems can be highlighted when put in a specific patient situation with the responsibility of writing out the prescription. Practical skills such as catheterisation are taught using simulation and models, yet prescribing is often taught with a more theoretical approach. It is therefore really useful to practise writing on real drug charts. This can be done by practising prescribing scenarios with other students using specific patient examples, or writing mock prescriptions for patients after seeing them on the ward. This is an excellent way of practising because when presenting the history and examination to a senior or presenting on the post take ward round, the mock drug chart can also be checked. This gives valuable feedback to the student and highlights common and easy to make mistakes. It is much better to learn this way than to make the mistakes in real life. Of course, it is imperative that the mock drug chart is not confused with the real drug chart. This could be avoided by writing 'Student Practice Drug Chart: Not for Ward Use' on the front and doing it away from the bedside.

Simulation tutorials can also be useful for learning about prescribing. These consist of students being given a simulated patient case (which could be a written case) and being asked to prescribe on drug charts for the first 5 to 30 minutes of the patient's care. This simulates the situation that occurs when seeing any new patient as a junior doctor, with the focus being to stabilise the patient before a senior can come to help (Woodfield *et al.*, 2014).

Being a junior doctor

Common bleeps relating to prescribing

Many of the common bleeps that a new doctor receives involve aspects of prescribing. Most common requests include prescriptions for analgesia, antiemetics, laxatives, IV fluids, warfarin and sedation for agitated/aggressive patients. Medication review may also be requested for confused patients or those with new renal impairment. Medications may also be implicated in other requests, such as requests to review a patient with new confusion, a rash, diarrhoea, low blood pressure or high/low heart rate.

Things I wish I had known

Six things I wish I had done on Week 1 to help with prescribing:

1. Printed out the protocols for common presentations for quick reference: Diabetes Ketoacidosis (DKA) Insulin Chart, Acute Coronary Syndrome Protocol, Antibiotic Guidelines. Each hospital has slightly different guidelines.
2. Bought a clipboard for storage and instant access to spare blood forms, X-ray request forms, blood gas syringes, endoscopy request forms and blank sheets of paper.
3. Always had more than one pen.
4. Put out gentamicin level blood forms for the phlebotomist the day before with the time specified, so that the prescription can be reviewed effectively the following day.
5. Included patient's allergies on the ward handover list – particularly if there is history of anaphylaxis.
6. Written down the bleep numbers of all key people that I might need, rather than wasting time going through the switch board – this includes the pharmacist, physiotherapist, occupational therapist, microbiologist, biochemistry, haematology, transfusion and radiology departments.

What to do when you don't know

- **Ask** – it is always best to check prescriptions, as the potential damage is huge. This includes patient safety considerations, patient harm/death, breach of trust, upset, as well as legal and litigation considerations.
- Ask your senior if there is any misunderstanding about the indication or preparation of an intended

drug, and check with the pharmacy the dosing, always ensuring that they have taken into account other factors such as allergies and renal function. This is both of your responsibilities, but you are likely to know the patent better and are in a good position to give this vital information.

- The microbiology registrar/consultant are frequently the go-to individuals for advice regarding antibiotics and antivirals.
- If there is doubt about a person's regular medication, or dosing at home, the GP practice should have an up-to-date prescription list that they can fax to you. GP surgery secretaries will sometimes read these out over the phone, but a fax is a much more reliable written record. Family members are often also very useful for this, but care must be taken not to rely on the word of a non-qualified individual, particularly if you have no written record of the medications they are recommending.
- Part of the pharmacist's job for every new admission is medicine reconciliation. This means checking that all the medications that a patient is taking at home have been accounted for and that the doses are correct. This is a safety net where the drug history is unclear.

Common pitfalls

Poor renal function

Renally excreted drugs will accumulate in the body if renal function is impaired. This means that less of the drug is required to have the same effect. If the usual medication dose is given to someone with renal failure, the medication may become toxic or may over-exert its effects, as the concentration in the blood will be much higher than anticipated. Renally excreted drugs therefore must have their doses adjusted before being given to renally impaired patients. This is explained fully in Chapter 10 Renal.

The BNF has a section on renal impairment, with corrected doses depending on the creatinine clearance (BMA/RPS, 2015). There is also a renal handbook, which is very useful and freely available online, endorsed by the UK Renal Pharmacy Group (Ashley *et al.*, 2009).

However, it is essential that junior doctors are aware of the commonly prescribed drugs that need adjusting in renal failure (please see Chapter 10 Renal for full information):

1. Metformin causes lactic acidosis in renal failure. Consider sliding scale insulin as a replacement if blood sugar needs controlling in this situation.
2. Angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), spironolactone and furosemide all worsen renal failure and should be withheld in acute kidney injury (although furosemide is sometimes used in acute kidney impairment [AKI]).
3. Antibiotic (in particular gentamicin and vancomycin) levels must be taken to guide dosing to avoid severe nephrotoxicity and ototoxicity. Augmentin IV and Tazocin also have renal dosing regimes (BD rather than TDS).
4. Low molecular weight heparin is usually given at half the dose for people with an estimated glomerular filtration rate (eGFR) <30.
5. Digoxin is renally excreted and will therefore accumulate in renal failure. This is very important to be aware of as it also has a narrow therapeutic index, meaning it will cause toxicity at a relatively low level. Digoxin levels must therefore be taken and digoxin withheld if there is any suspicion of toxicity.

Pregnancy

In any pregnant person, the risk versus benefits must be considered of any medication, as any drug in the mother's blood stream has a risk of affecting the fetus. The BNF has a section on pregnancy (BMA/RPS, 2015). For many common drugs there is enough evidence of their use in pregnancy to be confident that there is little risk to the fetus (e.g. laxatives, paracetamol, some antiemetics and omeprazole). However, there are very few trials on pregnant women, and this tends to be a relatively healthy group, so there is often limited evidence regarding safety of drugs. It is therefore always best to look up all intended prescriptions in the BNF or potentially ask a member of the obstetrics and gynaecology team, as they have the most experience of prescribing in pregnancy. Please see Chapter 14 Obstetrics and Gynaecology.

The elderly

Elderly patients bring a further set of prescribing considerations (see Chapter 8 Care of the Elderly). The prescription itself may need to be altered as body weight may be <50 kg; however, the formulation of the medication may also need alteration. Some tablets are large and may be difficult to swallow, hence liquid preparations may be more appropriate, or a person may find capsules easier than tablets. Pill burden may also be a consideration and combination tablets may reduce this (e.g. co-codamol rather than codeine and paracetamol separately). Tablets may also need to be spaced throughout the day to make the regimen more manageable, as a difficult and troublesome regimen will increase the chances of poor compliance.

Polypharmacy is also a concern from the perspective of drug interactions, possibility of harm from side effects as well as increased chance of poor compliance. The ability to rationalise medications is very important, and often falls to GPs and care-of-the-elderly physicians, but it should be every doctor's job. Rationalising medications involves weighing up the potential benefit of the medication versus the harm, and thereby stopping non-essential drugs with the aim of prioritising the patient's main health problems and quality of life. One example could be stopping a statin in an elderly man who is struggling to swallow tablets, as a statin has a long-term benefit which the patient may not receive. This rationale could stand for any primary or secondary preventative medication in an elderly or very unwell patient.

Allergies

Beware of allergies to specific drugs, particularly serious allergies, as the patient may well be allergic to other medications in that group. For example, an allergy to ramipril is likely to infer an allergy to lisinopril. There are also cross-over allergies. For example, a percentage of patients who are allergic to penicillins are also allergic to cephalosporins, thought to be because they share a common betalactam ring. This should only influence prescribing if the allergy is a serious anaphylactic reaction, as otherwise this would rule out a whole class of antibiotics to a lot of patients unnecessarily. Also, the rate of serious reactions is only around 0.04–0.08% (Herbert *et al.*, 2000) (see Chapter 11 Microbiology). However, it is also true that patient with serious penicillin allergies are more likely to be allergic to any class of antibiotic, hence caution is required with all antibiotic prescriptions.

Morphine preparations

Morphine must be prescribed with its brand name as well as its route, as this greatly affects its absorption, speed of onset and duration of action. Morphine can be given IV, SC, topically, as an IV or SC infusion, orally in tablets or orally in liquid. Please see Chapter 7 Surgery on analgesia, as well as Chapter 9 Anticipatory prescribing at the end of life on prescribing in palliative care. The route and formulation are greatly affected by the type of pain, potential for reversibility and co-morbidities of the patient.

Hyponatraemia

Hyponatraemia can lead to confusion and drowsiness and may contribute to poor quality of life and falls. Low sodium levels can be iatrogenic, hence this must be considered in patients with a persistently low sodium.

Drugs that worsen hyponatraemia are:

1. Non-steroidal-anti-inflammatory drugs (NSAIDs) cause increased total body water, therefore have a dilutional effect. They lead to euvolaemic hyponatraemia, and have no effect on total body sodium.
2. Thiazide and loop diuretics increase renal water losses and cause the excretion of urine that is sodium and potassium-rich (Sterns, 2011). Loop diuretics are less likely than thiazides to cause hyponatraemia, unless they cause severe volume depletion (Agrawal *et al.*, 2008).
3. Antidepressants, including tricyclics and selective serotonin reuptake inhibitors (SSRIs), can lead to the syndrome of inappropriate secretion of antidiuretic hormone (SIADH). This is thought to be because serotonin is involved

in regulating ADH secretion (Kadowaki *et al.*, 1983). SIADH can be managed by fluid restriction, but consultation with a psychiatrist may be required to consider alternative antidepressants (such as a monoamine oxidase inhibitor).

4. Morphine and other opioids can have an antidiuretic action, leading to euvolaemic hyponatraemia (Porter and Kaplan, 2011).
5. Carbamazepine increases total body water with whole-body sodium levels unaffected, causing euvolaemic hyponatraemia (Porter and Kaplan, 2011).

Cardiac failure

Any drug that slows heart rate or reduces myocardial contractility may potentially exacerbate heart failure in someone with a chronically failing heart. Please see Chapter 3 Cardiology.

Drugs to be aware of in heart failure are:

1. Beta blockers slow heart rate and depress myocardium, hence are contraindicated in acute cardiac failure as they are likely to worsen pulmonary oedema. However, low-dose beta blockers have prognostic benefits for chronic cardiac failure (CCF), but high doses can precipitate acute deterioration. The dose therefore needs titration. Bisoprolol and carvedilol have the most evidence in CCF. Patients with CCF should therefore be on a beta blocker unless it cannot be tolerated (see Chapter 3 Cardiology).
2. Dihydropyridine Ca channel blockers (amlodipine, nifedipine) are negatively ionotropic and reduce myocardial contractility.
3. Phenylalkylamine Ca channel blockers (verapamil and diltiazem) are highly negatively ionotropic, and depress cardiac function, more than the Dihydropyridine Ca channel blockers (see BNF [BMA/RPS, 2015]).
4. Flecainide can have proarrhythmic effects in CCF (see BNF [BMA/RPS, 2015]). Do not give if there is a history of myocardial infarction.
5. Fast IV fluid/blood has an increased risk of fluid overload in CCF, therefore caution and reassessment are needed. The solution is slow maintenance fluid replacement and giving 1 unit blood over the maximum time (4 hours) with furosemide cover.

Compliance

Even with the best prescribing knowledge, no benefit will be transferred to the patient without compliance to the intended medication regimen. This is a complex area as there are many reasons why patients do not take their medications. The key reasons that doctors can ensure are eliminated are lack of adequate explanation and poor understanding of the rationale. It is the doctor's and pharmacist's job to explain why medications will be useful and what the expected effects will be. If there is a lag before the drug will become effective the patient must know about this so that they don't give up on the drug too early. They also must be advised about what to do in the event of side effects, as many of these can be easily managed without withdrawing the drug.

The patient must also have faith in the medical professional and trust that the medication may help them. Without this, it is unlikely that they will take it.

Other factors may be social stigma, such as in a young diabetic having to inject insulin at meal times, or an HIV-positive patient having to take antiretrovirals. This can be addressed by exploring the patient's ideas, concerns and expectations and trying to find a solution.

Side effects, or perceived side effects, are of course a large reason for poor compliance. A large pill burden or necessity for frequent medication throughout the day may also influence compliance. Some drugs also require frequent monitoring, such as warfarin requiring regular INR blood tests. These factors may culminate in patients missing appointments and missing medications.

The patient must also have a desire to improve their symptoms. Some individuals have given up hope and may have very low mood, meaning that they no longer have the will to improve their condition. Alternatively, patients may feel they can help themselves without the need for medical input, and may prefer to take homeopathic or alternative therapies first.

SUMMARY

Prescribing is a skill requiring knowledge of pharmacology, pharmacokinetics and pharmacodynamics, memory and understanding of dosings and ability to adapt the situation to an individual's circumstances and foresee complications. This all comes with experience. There are many resources to help with this before and during working as a doctor.

The 'DRUGS' safety check

Before prescribing a medication, every doctor should run through the 'DRUGS' safety check in their mind. This will be a recurring theme in the textbook, aiming to become a memorable safety check that junior doctors think of when they put pen to paper.

What **dose**, which **route**, which **units**, how often/fast **given** and what **special situations** to consider.

We believe that every student who subscribes to the 'DRUGS' checklist will avoid dangerous drug errors.

DRUGS checklist	
Dose	**Dosage**
Route	Route given e.g. IV, ORAL, IM
Units	mg, microgram, units
Given	Over 30 minutes, OD, BD, TDS, QDS
Special situations	Contraindications, allergies, pregnancy, breast feeding

FURTHER READING

- The official Prescribing Safety Assessment website is: British Pharmacological Society (2011). *Prescribing Skills Assessment*. Available at: https://prescribingsafetyassessment.ac.uk/. This explains the exam aims and objectives, as well as format, style and question structure. There is also a useful resources page.
- There is an excellent website with practice questions for PSA preparation, available at www.prepareforthepsa.com/. This is useful for general preparation for being a doctor, as well as exam preparation (Catling F, Williams J, Baker R (2014). A prescribing e–tutorial for medical students. *Clinical Teache*r **11**: 33–7).
- The *British National Formulary* (BNF) (BMA/RPS, 2015) is a must have for any prescriber; it is also available online at: www.bnf.org
- *The Pocket Prescriber* is a hand-held practical guide, useful when on the job as a junior doctor: Nicholson TRJ. *Pocket Prescriber*, 5th edn. Hodder Arnold: London, 2012.
- There is a *Student British Medical Journal* article dedicated to giving advice on preparing for the Prescribing Skills Assessment and preparing to be a junior doctor. This is useful as a summary, and is written from the perspective of a medical student and a junior doctor: Woodfield G, O'Sullivan M, Lillie A *et al.* (2012). Practical prescribing. *Student BMJ* **20**: 34–6.

Now visit **www.wileyessential.com/pharmacology** to test yourself on this chapter.

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CHAPTER 2

Emergency Department

Victoria Taylor

Key topics:

NB. Other topics that would primarily be dealt with by emergency physicians or acute medicine physicians include: sepsis, acute arrhythmias, diabetic ketoacidosis and seizures. These are dealt with separately in the relevant specialty chapters.

Learning objectives

By the end of this chapter you should…

- …be able to recall the name, dose and route of administration for the key drugs used in anaphylaxis and cardiac arrest.
- …be able to describe the treatment of paracetamol overdose and acute alcohol withdrawal syndrome.
- …be aware of some of the difficulties of producing an evidence base for emergency scenarios.

Essential Practical Prescribing, First Edition. Georgia Woodfield, Benedict Lyle Phillips, Victoria Taylor, Amy Hawkins and Andrew Stanton. Published 2016 by John Wiley & Sons, Ltd.

Cardiac arrest

Mr Thomas Lane

Age: 62

Hospital number: 123456

Case study

Presenting complaint: *A 62-year-old man has been brought into the Emergency Department by ambulance with chest pains. The ambulance crew have already given him 300 mg aspirin.*

This is his ambulance sheet and rhythm strip (Figure 2.1):

Ambulance sheet:

A: *No known allergies*

M: *bisoprolol, ramipril, aspirin, omeprazole, tamsulosin*

P: *MI 5 years ago – two stents, HTN, borderline diabetes, prostate problem*

L: *2 hours ago*

E: *Chest pain started around 3 PM; tried taking Gaviscon but no improvement; some SoB; wife concerned so called 999. Smoker.*

Ambulance sheets

Ambulance sheets are often a great source of information. Paramedics sometimes record their information using the acronym AMPLE

A: Allergies

M: Medications

P: Past medical history

L: Last ate

E: Events

Before you manage to go and see him, an arrest call goes out.

Initial measures

Confirm cardiac arrest then ensure the call for help has gone out before immediately starting basic life support (BLS). Once further help is available, move to providing advanced life support (ALS) as per standard guidelines from the Resuscitation Council (see Further Reading).

Prescribing in cardiac arrest

Ideally, someone should be documenting the cardiac arrest as it happens; this includes keeping a record of medications that have been administered. There will not be time to prescribe each treatment before it is given and prescriptions may, in this exceptional circumstance, be written in retrospect.

ONCE ONLY PRESCRIPTIONS

Date	Time to be given	DRUG	Dose	Route	Prescriber	
					Signature	Bleep
xx/xx/xx	xx:xx	ADRENALINE 1:10,000	1 mg	IV	*A. Doctor*	

According to current ALS guidelines (Resuscitation Council (UK), 2015) adrenaline should be given every 3–5 minutes during cardiopulmonary resuscitation (CPR). It is important to state the *concentration* as well as the total *quantity* (dose) of

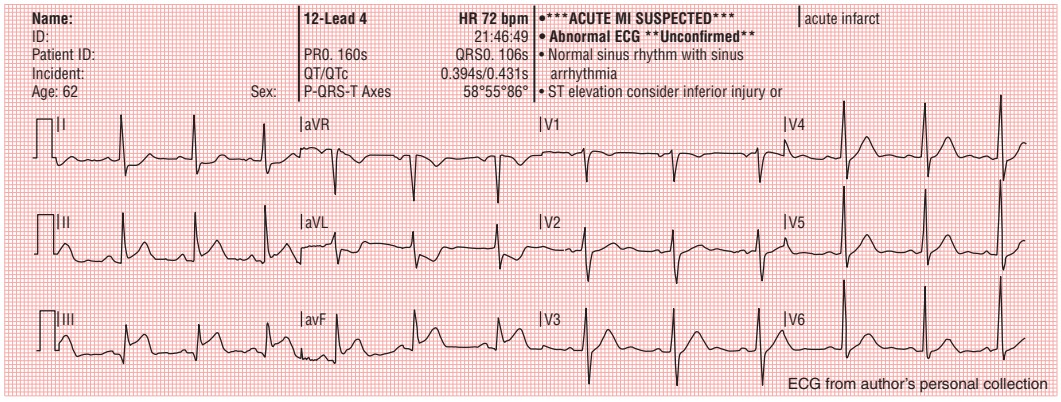

Figure 2.1 Cardiac arrest case study rhythm strip.

adrenaline being administered. You may know that adrenaline is also given in anaphylaxis but there are important differences in the prescriptions. In cardiac arrest the adrenaline is 10× as dilute (1:10 000 rather than 1:1000) **and** the route is different; it is intravenous (IV) as opposed to intramuscular (IM). Adrenaline given in anaphylaxis is concentrated so that 0.5 mL rather than 5 mL doses can be given IM.

Administering medications during resuscitation

Don't forget that without the usual pump action of the heart, there is no circulation of blood and, although chest compressions provide some degree of circulation, it is still much harder for the medications given to be distributed. It is therefore recommended that medications given intravenously during a cardiac arrest should be followed by a 20-mL flush to facilitate entry into the central circulation (Neumar *et al.*, 2010).

If intravenous access cannot be established, medication can be given via the intraosseous route. This has long been established as a means of gaining access in paediatric emergencies and can now also be recommended in adults. In the past, medications have been administered via the trachea but the absorption and doses are difficult to predict and alternative routes are preferred (Deakin *et al.*, 2010).

[TOP TIP] Adrenaline and other emergency medication often come pre-made-up in a special device, such as a 'mini-jet'. It's a good idea to learn how to use these before you need to use one in an emergency. You could ask your local Resus Officer or one of the emergency medicine physicians to show you.

Adrenaline in cardiac arrest: rationale and evidence

The theoretical benefit of adrenaline during cardiac arrest lies mainly in its ability to cause vasoconstriction of peripheral vasculature, thereby improving myocardial perfusion. However, there is little evidence to support its use and there is now some emerging evidence that it may be non-beneficial or even harmful (see Evidence). At the time of writing, the Resuscitation Council still favours its use during CPR, although it is important to note that CPR should not be interrupted to administer this medication.

Evidence

Evidence is difficult to obtain in arrest situations but some studies have been carried out which suggest that adrenaline improves the chances of return of spontaneous circulation (ROSC). No study has determined the optimal dose or number of doses that should be used. There is no good evidence that the use of adrenaline during cardiac arrest improves the chances of survival to discharge and, worryingly, more recent reviews of the available evidence suggest that the use of adrenaline may be associated with poorer long-term outcomes (Callaway, 2013; Miller, 2013). Further studies are underway, including a randomised control trial (RCT).

DRUGS checklist for ADRENALINE in cardiac arrest

Dose **Dilution**	1 mg 1/10 000
Route	IV
Units	Milligrams (mg)
Given	Every 3–5 min
Special situations	Adrenaline is kept on all crash trolleys, usually in a 10-mL prefilled syringe. Be aware that the dose and route used in cardiac arrest is different to that used in anaphylaxis.

Adrenaline: essential pharmacology

Adrenaline (or epinephrine if you're American) is an adrenoceptor agonist and acts as a neurotransmitter in the sympathetic nervous system. Adrenoceptors are G-protein coupled receptors (GPCRs) which sit on the cell surface and, in response to an agonist (e.g. adrenaline), trigger specific intracellular events. Subtypes of adrenoceptor include α1, α2, β1, β2 and β3 (Rang *et al.*, 2003). Some of the actions mediated by these receptors are listed below:

- α1-receptors mediate contraction of vascular smooth muscle, inducing peripheral vasoconstriction.

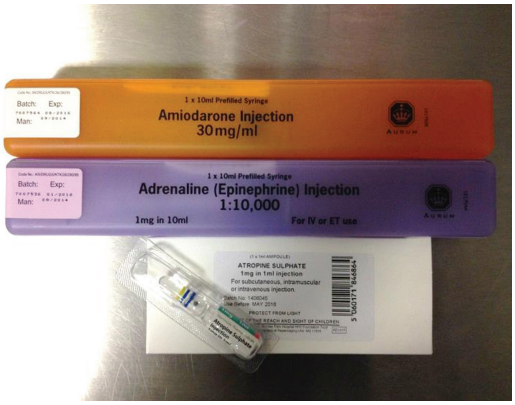

Figure 2.2 Medications from the cardiac arrest trolley.

- α2-receptors are responsible for negative feedback at nerve terminals and also decrease insulin secretion.
- β1-receptors mediate increases in the rate and force of myocardial contraction.
- β2-receptors mediate smooth muscle relaxation, inducing bronchodilation in the lungs, reduced motility of the GI tract and also relaxation of uterine muscle (tocolysis).
- β3-receptors promote lipolysis in adipose tissue.

Be aware that beta-blockers and other adrenoceptor *antagonists* may blunt the effect of adrenaline in this situation.

Other medications used in cardiac arrest

Amiodarone: Expert consensus is that if ventricular fibrillation/ ventricular tachycardia (VF/VT) does not respond to three shocks, 300 mg IV amiodarone can be given as a bolus, followed by 900 mg IV amiodarone over the next 24 hours (Figure 2.2). If amiodarone is unavailable, lidocaine 1 mg/kg may be used.

Magnesium: This is only indicated if the arrest is due to polymorphic ventricular tachycardia (torsades de pointes).

Sodium bicarbonate: This is only indicated if the arrest is due to hyperkalaemia or tricyclic antidepressant overdose.

Case outcome

After one cycle of CPR, during which adrenaline was given, the rhythm was assessed and Mr Lane was found to be in VF: a shockable rhythm. He received a shock, and CPR was immediately resumed for 2 min. At the pulse check, he was found to have 'return of spontaneous circulation' (ROSC). He was stabilised and transferred to ITU. A coronary angiogram was subsequently performed which showed single-vessel disease. A drug-eluting coronary stent was used to open up the vessel and Mr Lane recovered in the Coronary Care Unit.

Although this case had a good outcome, less than 20% of patients who suffer an in-hospital cardiac arrest survive to discharge, despite the best care we can provide (Nolan *et al.*, 2014). The chances of surviving are higher if the patient develops a shockable rhythm.

Common pitfalls

- Be aware of the different concentrations of adrenaline available:
  - Adrenaline in cardiac arrest: 1 mg of **1 : 10 000** (10 mL)
  - Adrenaline in anaphylaxis: 500 micrograms of **1 : 1000** (0.5 mL).
- Note that atropine no longer appears in the ALS treatment algorithm (it previously appeared as part of the treatment of pulseless electrical activity (PEA)/ asystole arrests.

SUMMARY

Every doctor should be familiar with the medications used in cardiac arrest, along with their doses and routes of administration. An ABC approach is warranted, as is early senior input, notably from an emergency physician or an anaesthetist.

Key learning points

Cardiac arrest

- Currently recommended medication is: 1 : 10 000 adrenaline, 1 mg IV every 3–5 minutes.
- Adrenaline should be given as soon as possible in non-shockable cardiac arrest situations. Shocks should not be delayed to give adrenaline in shockable rhythms.

FURTHER READING

- The Resuscitation Council provides fantastic up-to-date guidelines for how to manage cardiac arrest and periarrest scenarios, available at: www.resus.org.uk/
- A good review of recent evidence with discussion of the potential benefits and harms of adrenaline in cardiac arrest is: Callaway CW (2013). Epinephrine for cardiac arrest. *Curr Opin Cardiol* 28: 36–42.

Anaphylaxis

Ms Carey Patterson

Age: 22

Hospital number: 123456

Case study

Presenting complaint: *A 22-year-old woman was brought into the Emergency Department having suffered an allergic reaction of unknown cause. When the paramedics arrived she was short of breath with tongue swelling. She was treated for anaphylaxis and is being monitored in the Observation Unit. It is now 6 hours since she was first admitted and you are called to see her by one of the nurses as she is starting to feel short of breath.*

PMH: *Asthma (no previous ITU admissions)*
DH: *See prescription*
Allergies: *Oxytetracycline (causes a rash), aspirin (causes wheeze)*
SH: *Studying history at university; lives with 3 flatmates; non-smoker, alcohol: 15–30 units/week.*
O/E: *Ms Patterson is sitting upright and is clearly in distress. She is using her arms to fix her rib cage and support her breathing. She responds to questions by nodding/ shaking her head but cannot talk. There is a raised, red rash around her neck.*

A*irway: Unable to talk, mild stridor*
B*reathing: RR: 28; Sats: 96% OA*
- *Air entry on both sides, mild wheeze*

C*irculation: HR: 120; BP: 85/50*
- *CRT <2 seconds; HS I+II+O*

PHARMACY STAMP

AGE 22

D.O.B. 12/02/1994

FORENAME, SURNAME Carey Patterson

ADDRESS 2A, Southampton Street

NHS NUMBER

SALBUTAMOL (100 micrograms per dose), inhaled.
Take 2 puffs as required.

BECLOMETASONE (100 micrograms per dose), inhaled.
Take 2 puffs twice a day.

MICROGYNON 30, oral.
Take as directed.

SIGNATURE OF PRESCRIBER DATE

SP21000